the upper vertical with the horizontal, the average error was 10.83 mm. against the vertical when the left horizontal was taken, and 7.70 mm. against it when the right was taken. Here, again, the results show the greater overestimation of the lower arm of the cross.

The results at large are very well summarized in the following manner: First, in regard to the correctness of the estimates of magnitudes, the comparisons of the horizontal arms of the cross with each other by both eyes were the only cases approximating accuracy. In the other cases, (1) the lower arm compared with the upper, was uniformly overestimated; (2) the right arm compared with the left was overestimated; (3) in comparisons of the vertical with the horizontal arms, the lower was overestimated more than the upper vertical. Second, the results also show (1) that the estimates follow the psychophysical law, and (2) that the variable error was only half as great in dividing as in comparing lines, a fact which is construed as proving the practicability of the method of the least observable differences.

In the second paper, describing the experiments for comparing and measuring angles, a circle about 36 cm. in diameter was drawn upon a dark background. This circle was divided accurately into definite portions of thirty degrees each, and these marked by threads issuing from the centre and movably fixed in the circumference. The experiments consisted in efforts to divide a given angle in one of the quadrants into equal parts. Assuming the centre of the circle as the point of fixation, the results would show, as in the case of the cross, the capacity of different portions of the eye for judging magnitudes. The mean or average error was assigned in terms of the percentage of the real half angle to be guessed, and marked with a plus or minus sign, according as the eye judged a quantity larger or smaller than the proper one. The first set of experiments was with the right eye, and the second with the left. The results showed perfect similarity between the two eyes, and were summed up by the author in the statement that "when the angle to be bisected was horizontal or approximately so, the upper angles were overestimated, and the lower underestimated." This was true of both halves of the visual field. The experiments represented attempts to halve angles varying from 10 to 150 degrees. Another and distinct set of experiments were efforts to divide 180 degrees equally, beginning at different points in the circumference. The results were practically the same for each eye, and were very striking in one respect. Beginning at zero, which was the terminus of the vertical diameter in the upper half of the circle, and proceeding to the right with every ten degrees as a starting point for the 180 degrees to be divided, the average error was always plus until seventy degrees were reached, when it became minus and remained minus until 150 degrees were reached, when it became plus again up to 180 degrees. Beginning at zero, or 360 degrees, again, and proceeding to the left, the same distances showed similar results. From 360 to 290 degrees, the average error was plus, and then became minus until 200 degrees were reached, when it was plus to 180. This means that the upper quadrants were overestimated in most cases, and the lower quadrants underestimated in most cases. J. H. HYSLOP.

Ueber Fusionsbewegungen der Augen beim Prismaversuche. von ALFRED GRAEFE. Archiv für Ophthalmologie (1891).

The object of the author is to throw light by special experiments on the question whether binocular accommodation is native or em-

pirical, and to test the comparative strength of the two opposite tendencies to fusion, according as the images are homonymous or heteronymous. The experiments were conducted between the limits of the parallel and the convergent position of the eyes. For testing the native and unalterable functions of binocular accommodation, a prism was used in front of one of the eyes, both horizontally and vertically. When the prism was placed horizontally, so as to produce homonymous images, the movements for fusion had to be divergent and the localization was apparently farther off than in reality, and when placed to produce heteronymous images, involving convergent movements for fusion, the localization was nearer than in reality. These facts are taken as indicating a native and fixed function for localization by binocular adjustment. The result was similar for the vertical position of the prism, which had the effect of throwing the images upon different planes in the retina, and there was no appreciable tendency to fusion, even when they could be brought into the median plane. The author, however, found some slight limitations to the absolute fixity of this law. Even in those cases where vertical fusion seemed to take place, there was reason to regard them as abnormal and exceptional. In regard to the comparative strength of the convergent and the parallel movements of the eyes, experiment seemed to show that the convergent were slightly the stronger. J. H. HYSLOP.

Ueber den Einfluss der Geschwindigkeit des Pulses auf die Zeitdauer der Reactionszeit bei Schalleindrücken. VAN BIERVLIET. Wundt's Philos. Studien, X. (1894), 160-167.

Dr. van Biervliet has measured the sensory reaction-times of eleven university students to auditory stimulation and compared these with pulse rates found by careful counting just before taking the reactions. The instrument used was the Hipp chronoscope, regulated at intervals with the new model Leipzig *Control-hammer*. Six of the eleven subjects showed a regular quickening of the reaction-time with acceleration of the pulse. Four others showed something of the same tendency, but failed at the extremes of fast or slow pulse, and one observer exactly reversed the rule. In view of these more or less discordant cases and of the large size of the mean variation (as in all sensory reactions) when compared with the differences to be established, the quickening of the reaction-time with the pulse rate must be regarded as probable rather than proved. No statement is made as to possible changes in pulse rate during the time of taking a series of reactions, nor are the reasons given for the high pulse rates found sufficiently explicit. One would like to know how far the quickening was due to active exercise and how far to excitement, which last has already been shown (this JOURNAL, IV., 524) to quicken both sensory and muscular reaction-times. Possibly these data may be more fully furnished in the report of experiments on reactions to optical and dermal stimuli that is to be furnished later.

Einige Versuche mit der Wunderscheibe. GRÜTZNER. Pflüger's Archiv, LV., 1893, 508-520.

The author first describes two lantern methods for demonstrating stroboscopic phenomena simultaneously to a large company of spectators. The first presents a single figure in motion, the second a full set of figures. For the full description of these, which cannot be described in short space without the diagrams, the reader is